Developer Note

Enhanced Power Macintosh Computers

Power Macintosh 6100/66
Power Macintosh 7100/80
Power Macintosh 8100/100
Power Macintosh 8100/110

Developer Note

Developer Press
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About This Developer Note

This developer note describes the Apple Power Macintosh 6100/66, 7100/80, 8100/100, and 8100/110 computers, being introduced in October–January, 1994–95.

These new models are enhanced versions of the Power Macintosh 6100/60, 7100/66, and 8100/80 computers introduced in March, 1994. This developer note covers only the enhancements that make the new models different. For more general information about the first generation of Power Macintosh computers, see *Macintosh Developer Note Number 8*, described in "Supplementary Documents," later in this preface.

This note is written for professional hardware and software engineers. You should be generally familiar with existing Macintosh technology, including NuBus™ and the new Apple RISC technology based on the PowerPC microprocessor. For recommended reading material about Macintosh technology, see the documents listed in "Supplementary Documents," later in this preface.

Contents of This Book

This developer note contains two chapters and one appendix:

- Chapter 1, "Power Macintosh 6100/66, 7100/80, and 8100/100," covers the configurations of these models and their differences from the Power Macintosh computers introduced in March, 1994.
- Chapter 2, "Power Macintosh 8100/110," covers the additional differences in the Power Macintosh 8100/110, currently the fastest and most versatile Macintosh computer.
- Appendix A, "Power Macintosh RAM Layout," describes the random-access memory layout for both the current Power Macintosh models and the models introduced in March, 1994.

Supplementary Documents

The documents described in this section provide information that complements or extends the information in this developer note.

Apple Publications

Apple Developer Press publishes a variety of books and technical notes designed to help third-party developers design hardware and software products compatible with Apple computers.

Inside Macintosh is a collection of books, organized by topic, that describe the system software of Macintosh computers. Together, these books provide the essential reference for programmers, software designers, and engineers.

The original version of *Inside Macintosh* was published in six volumes. The newer volumes of *Inside Macintosh* are organized by topic. Current books include the following titles:

Inside Macintosh: AOCE Application Interfaces
Inside Macintosh: AOCE Service Access Modules
Inside Macintosh: Devices
Inside Macintosh: Files
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Inside Macintosh: QuickDraw Utilities
Inside Macintosh: QuickTime
Inside Macintosh: QuickTime Components
Inside Macintosh: Sound
Inside Macintosh: Text

Inside Macintosh: PowerPC System Software covers in detail the changes and extensions to Macintosh system software version 7.1 for Power Macintosh computers, including new Macintosh Toolbox managers and the run-time architecture that supports the PowerPC microprocessor.

Building Programs for Macintosh With PowerPC is a general discussion for developers of the development and building of application software for PowerPC processor–based Macintosh systems.

Designing Cards and Drivers for the Macintosh Family, third edition, explains the general hardware and software requirements for NuBus cards and drivers compatible with the first generation of Power Macintosh computers.

Technical Introduction to the Macintosh Family, second edition, surveys the complete Macintosh family of computers from the developer's point of view.

Macintosh Human Interface Guidelines provides authoritative information on the theory behind the Macintosh "look and feel" and Apple's standard ways of using individual interface components. A companion CD-ROM disk, *Making It Macintosh,* illustrates the Macintosh human interface guidelines through interactive, animated examples.

Macintosh Developer Note Number 8 contains two documents: *Power Macintosh Computers* describes the Power Macintosh 6100/60, 7100/66, and 8100/80 models; *Macintosh DAV Interface for NuBus Expansion Cards* describes the interface through which NuBus expansion cards can access the raw digital sound and video data streams available in Power Macintosh computers.

New Technical Note ME 9 discusses techniques for accessing discontinuous physical memory spaces in Macintosh computers. The current Power Macintosh RAM space is divided into physically discontinuous 32 MB segments, as described in Appendix A, "Power Macintosh RAM Layout." You can get *New Technical Note ME 9* from the Apple Developer Technical Support department.

Most of the Apple publications just listed are available from APDA. APDA is Apple's worldwide source for hundreds of development tools, technical resources, training products, and information for anyone interested in developing applications on Apple platforms. Customers receive the *APDA Tools Catalog* featuring all current versions of Apple development tools and the most popular third-party development tools. APDA offers convenient payment and shipping options, including site licensing.

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Conventions and Abbreviations

This book uses the following typographical conventions and abbreviations.

Typographical Conventions

Computer-language text—any text that is literally the same as it appears in computer input or output—appears in `Courier` font.

Hexadecimal numbers are preceded by a dollar sign ($). For example, the hexadecimal equivalent of decimal 16 is written as $10.

Note
A note like this contains information that is interesting but not essential for an understanding of the text. ◆

Abbreviations

Abbreviations for units of measure used in this book include

GB	gigabytes	MB	megabytes
KB	kilobytes	MHz	megahertz

Other abbreviations used in this book include

ASIC	application-specific integrated circuit
CPU	central processing unit
DAV	digital audio/video
DRAM	dynamic random-access memory
I/O	input/output
RAM	random-access memory
RISC	reduced instruction set computing
ROM	read-only memory
SIMM	single inline memory module
VRAM	video random-access memory

CHAPTER 1

Power Macintosh 6100/66, 7100/80, and 8100/100

Power Macintosh 6100/66, 7100/80, and 8100/100

This chapter describes the Power Macintosh 6100/66, 7100/80, and 8100/100 computers. These new models differ from the first Power Macintosh models in speed and a few minor part changes. The Power Macintosh 8100/110 computer, which embodies additional changes, is described in Chapter 2.

Configurations

Initial shipping configurations for the Power Macintosh 6100/66, 7100/80, and 8100/100 models are listed in Table 1-1.

Table 1-1 Shipping configurations

Model number	DRAM size, MB	Hard drive size, MB	CD-ROM?	AV card?	DOS/Windows capability?
Power Macintosh 6100/66 models					
M3631	8	350	No	No	No
M3632	8	350	Yes	No	No
M3633	16	350	No	No	Plug-in card
M3634	16	350	Yes	Yes	No
Power Macintosh 7100/80 models					
M3641	8	350	No	No	No
M3642	8	500	No	No	No
M3643	8	700	Yes	No	No
M3644	16	700	No	No	SoftWindows
M3645	16	700	Yes	Yes	No
Power Macintosh 8100/100 models					
M3635	8	700	No	No	No
M3636	16	700	No	No	No
M3637	16	700	Yes	No	No
M3638	16	700	Yes	Yes	No
M3639	16	700	No	No	SoftWindows
M3640	16	1000	Yes	No	No
M3680	16	1000	Yes	Yes	No

Options and expansion capabilities for various models of the Power Macintosh 6100/66, 7100/80, and 8100/100 include the following:

- On all models without a CD-ROM, the user may add a CD-ROM in the field.
- In the Power Macintosh 7100 and 8100, models M3644 and M3639, compatibility with DOS and Windows programs is implemented in software, using SoftWindows™ 2.0 under license to Insignia Solutions. The Power Macintosh 6100/66, model M3633, contains the Macintosh DOS Compatibility card. Either DOS/Windows compatibility option requires 16 MB of DRAM to operate effectively.
- All configurations are shipped with 256 KB of second-level cache memory.
- All configurations are shipped with Macintosh system software release 7.5.

Other expansion capabilities, including maximum DRAM and VRAM capacities, are shown in *Macintosh Hardware Developer Note Number 8,* Table 1-2.

Clock Speeds

The Power Macintosh 6100/66, 7100/80, and 8100/100 models modify the information in *Macintosh Hardware Developer Note Number 8,* Table 2-2, as shown in Table 1-2.

Table 1-2 Model-specific clocks

Power Macintosh model	System clock frequency (MHz)	CPU bus clock frequency (MHz)
6100/66	66.0000	33.0000
7100/80	80.0000	40.0000
8100/100	100.0000	33.3333

Revised ROM and ASICs

The ROM and some of the ASIC chips described in *Macintosh Developer Note Number 8* have been updated for the Power Macintosh 6100/66, 7100/80, and 8100/100. The changes are described in this section.

NuBus Support

In the Power Macintosh 8100/100, the BART 4 NuBus controller chip used in other Power Macintosh models is being replaced by BART 21, which provides faster data transfers. Existing NuBus expansion cards should work with the Power Macintosh 8100/100; however, compatibility cannot be guaranteed. The Power Macintosh 8100/110 also uses the BART 21 chip, as described in Chapter 2.

The Power Macintosh 7100/80 and the optional NuBus adapter card for the Power Macintosh 6100/66 continue to use the BART 4 NuBus controller chip.

The BART 21 chip enables burst transactions for specific slots instead of for the bus as a whole. It also handles burst read transactions by NuBus masters. If these changes might affect your product, check with the Apple Developer Technical Support department for specific details.

NuBus support in the new ROM now lets you change the cacheability of a single, contiguous, ascending range of pages in NuBus superslot space, for each slot, using the `_HWPriv` trap. The Power Macintosh 7100 and 8100 models support write-through, copy-back, and cache-inhibited modes. The Power Macintosh 6100/66 and previous Power Macintosh models support only write-through mode.

You can use the following macros:

```
MACRO
_NuBusCacheWriteThru
MOVEQ    #16,D0
_HWPriv
ENDM

MACRO
_NuBusCacheCopyBack
MOVEQ    #15,D0
_HWPriv
ENDM

MACRO
_NuBusCacheInhibit
MOVEQ    #14,D0
_HWPriv
ENDM
```

The parameters to all three NuBus cache calls are identical. For example, the write-through call has the following form:

```
;   NuBusCacheWriteThru (_HWPriv Selector $10)
;
;  Selector for controlling the cacheability of NuBus space
;
;   Entry:
;        A0 (long)      - Page-aligned starting address
;        A1 (long)      - Length in bytes (should be a multiple of
                        - the native page size)
```

In the new ROM, support for addressing minor slot space has been extended from minor slot range 9 through E ($F9000000–$FE000000) to 1 through E ($F1000000–$FE000000). Major slot 8 is also now addressable.

The applicability of the NuBus changes just described to the new enhanced Power Macintosh computer models is summarized in Table 1-3.

Table 1-3 NuBus changes

Models	New ROM	BART 21	Slots supported	Slot-specific burst transactions
6100/66	No	No	Minor A–E, major A–E	No
7100/80	Yes	No	Minor A–E, major A–E	No
8100/100 8100/110	Yes	Yes	Minor 1–E, major 8–E	Yes

LocalTalk

The LocalTalk driver in ROM has been updated to improve LocalTalk performance. Products that use LocalTalk should be retested for compatibility.

Clock Chips

Some changes in clock chip vendors and part numbers have been made. These changes should be transparent to third-party software and expansion cards. Where the CPU bus rate is higher than in previous models, however, third-party DRAM expansion cards may need to be retested for compatibility.

CHAPTER 2

Power Macintosh 8100/110

Power Macintosh 8100/110

This chapter describes the Power Macintosh 8100/110 computer. This new model differs from the new Power Macintosh 8100/100 and from the original Power Macintosh 8100/80 in speed and in other ways. The Power Macintosh 8100/100 computer is described in Chapter 1. The Power Macintosh 8100/80 computer is described in *Macintosh Developer Note Number 8,* listed in "Supplementary Documents," in the preface.

Configuration

The Power Macintosh 8100/110 is shipped in a single configuration (model M3561) with these specifications:

- processor clock speed of 110 MHz
- 16 MB DRAM and 256 KB second-level cache
- 2 GB internal hard disk
- built-in CD-ROM
- Macintosh system software version 7.5

Clock Speeds

The processor clock in the Power Macintosh 8100/110 runs at 110 MHz.

The CPU bus clock rate is one-third of the processor rate, or 36.6667 MHz.

The Power Macintosh 8100/110 uses a new clock chip to accommodate these speeds.

New Cache

Apple supplies a new design of 256 KB cache SIMM for the Power Macintosh 8100/110. Third-party developers of cache expansion cards should check their products for compatibility with the 36.6667 MHz processor bus rate.

NuBus and ROM changes

The Power Macintosh 8100/110 contains the BART 21 NuBus controller chip and improved NuBus support in ROM, as described in "NuBus Support" beginning on page 3.

Power Macintosh RAM Layout

This appendix describes the physical layout of RAM in all current Power Macintosh models, including the Power Macintosh 6100/60, 6100/66, 7100/66, 7100/80, 8100/80, 8100/100, and 8100/110. Physical RAM addressing in these computers is discontinuous. If you are designing a NuBus expansion card that uses direct memory access to or from RAM, you should read this appendix.

RAM SIMMs

The current Power Macintosh logic board has 8 MB of RAM capacity soldered to the board. The user can install additional RAM capacity by plugging 72-pin SIMMs into the logic board. These RAM SIMMs are described in Chapter 4 of *Macintosh Developer Note Number 8*, listed in "Apple Publications," in the preface.

The PowerPC data bus is 64 bits wide, whereas Power Macintosh RAM SIMMs store data in 32-bit words. For this reason, the SIMMs must be installed in identical pairs. Each pair of SIMMs can provide from 1 to 32 MB of expansion, depending on their RAM chip configuration, added to the 8 MB of RAM on the logic board.

The physical RAM expansion capacity of various Power Macintosh models is shown in Table A-1. The RAM addresses shown in the right column are explained in the next section.

Table A-1 RAM SIMM expansion capabilities

Power Macintosh models	Maximum number of SIMMs	Maximum RAM capacity, MB	Highest accessible RAM address
All 6100	2 (1 pair)	72	$06FF FFFF
All 7100	4 (2 pairs)	136	$0EFF FFFF
All 8100	8 (4 pairs)	264	$1EFF FFFF

Discontinuous Physical Addressing

Each of the eight possible SIMMs in a Power Macintosh computer supports one 64 MB bank of memory, adding up to 512 MB. However, the portion of memory within each bank that a SIMM can access starts 16 MB after the lowest address of the bank and ends 16 MB before the highest address in the bank. The actual memory that a SIMM supports runs from the beginning of the accessible range. Hence there is a gap of at least 32 MB between the address ranges that any two adjacent SIMMs can support.

The 8 MB of RAM soldered to the logic board supports half of the 16 MB of memory space at the low end of bank 1 that is inaccessible to SIMMs.

The random-access memory map for a Power Macintosh 8100 with all four pairs of expansion sockets loaded with 32 MB SIMMs is summarized in Table A-2.

Table A-2 Power Macintosh 8100 memory map

SIMM pair	Memory bank	Addressing range, MB	Lowest and highest physical addresses
Logic board RAM		0–8	$0000 0000–$007F FFFF
1	1	16–48	$0100 0000–$02FF FFFF
	2	80–112	$0500 0000–$06FF FFFF
2	3	144–176	$0900 0000–$0AFF FFFF
	4	208–240	$0D00 0000–$0EFF FFFF
3	5	272–304	$1100 0000–$12FF FFFF
	6	336–368	$1500 0000–$16FF FFFF
4	7	400–432	$1900 0000–$1AFF FFFF
	8	464–496	$1D00 0000–$1EFF FFFF

As you can see from Table A-2, the maximum possible range of continuous physical memory in a current Power Macintosh computer is 32 MB. If the user installs smaller capacity RAM SIMMs, the maximum range is less. There is 8 MB of inaccessible space between the memory supported by the RAM soldered to the logic board and that supported by the first pair of SIMMs (if any); after that, there is at least 32 MB of inaccessible space between each continuous memory range and the next.

Several techniques are available for coping with discontinuous RAM addressing. For a full discussion, see *New Technical Note ME 9,* published by the Apple Developer Support department. This document is described in "Apple Publications," in the preface.

This Apple manual was written, edited, and composed on a desktop publishing system using Apple Macintosh computers and FrameMaker software. Final pages were created on an Apple LaserWriter Pro 630 printer. PostScript™, the page-description language for the LaserWriter, was developed by Adobe Systems Incorporated.

Text type is Palatino® and display type is Helvetica®. Bullets are ITC Zapf Dingbats®. Some elements, such as program listings, are set in Apple Courier.

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Special thanks to Sam Barone, Mark Baumwell, Steve Mackenzie, Brian Smith, and TeriAnn Wakeman.